

# Influence of colour-coded communication on biomonitoring results obtained by coke plant workers

## Introduction

Workers exposed to polycyclic aromatic hydrocarbons are monitored using different biomarkers (e.g. 1-hydroxypyrene, 3-hydroxybenzo[a]pyrene) to assess exposition and efficiency of personal protection equipment. Moreover, there are some data suggesting that the way how workers are informed about their exposure levels can induce positive changes in their behaviour and enhance adherence to safety guidelines, thus reducing the exposure in future. Evidence exists that colour-coding of the results can improve comprehension and encourage behaviour modification.

## Objectives:

to assess influence of colour-coded information on workers' internal exposure in subsequent years.

## Methods:

in a four-year follow-up (2015-2018), we analyzed biomonitoring results trends of 349 coke plant workers (out of 670), depending on the colour-coded initial information provided (Figure 1). The colours were assigned according to results range: green when the measured concentration was lower than 2.7 µg/g crea., yellow when the concentration was higher than 2.7 µg/g crea. but lower than 4.4 µg/g crea. and red when concentration was higher than 4.4 µg/g crea. Neither changes in personal equipment nor any substantial changes in used technology occurred in the analysed time.

Your results:

Sample:	Concentration
I: before the work-week	3,76 µg of 1-hydroxypyrene / g creatinine
II: after the 4th work-day	14,22 µg of 1-hydroxypyrene / g creatinine

Description of colours:

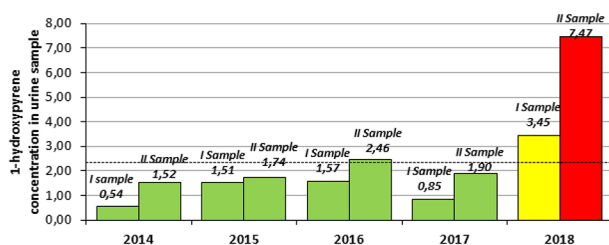
green	Your result is comparable to people who are not exposed to polycyclic aromatic hydrocarbons (PAH)
yellow	Concentration above 2,7 µg of 1-hydroxypyrene / g creatinine indicate higher exposition to PAH
red	Concentration above 4,4 µg of 1-hydroxypyrene / g creatinine may be harmful for health and indicate a elevated risk of cancer development

Your results:

Sample:	Concentration
I: before the work-week	2,79 µg of 1-hydroxypyrene / g creatinine
II: after the 4th work-day	0,78 µg of 1-hydroxypyrene / g creatinine

Description of colours:

green	Your result is comparable to people who are not exposed to polycyclic aromatic hydrocarbons (PAH)
yellow	Concentration above 2,7 µg of 1-hydroxypyrene / g creatinine indicate higher exposition to PAH
red	Concentration above 4,4 µg of 1-hydroxypyrene / g creatinine may be harmful for health and indicate a elevated risk of cancer development



Check if you use all personal safety measures against polycyclic aromatic hydrocarbons:	
	PAH can be inhaled and can attach to small particulate matter. • Do you remember to wear a safety mask? • Remember to change a worn-out mask as a new one will properly guard your lungs!
	PAH enter to your organism via your skin. Grimed hands allow the PAH to penetrate your skin and this is an important exposition PAH equally as via your lungs. • Do you always try to wash your hands properly after direct contact with PAH's sources?
	PAH can enter to your stomach with food eaten outside canteen, can affect your health. • Do you remember to wash hands before eating, even if they look rather clean? • Do you eat outside the canteen?
	PAH accumulate in grimed working uniforms and migrate to body via skin. • Do you remember to keep your underwear clean? • Do you change regularly your work uniforms (change after each shift)?
	PAH are present in the environment! • Smoking affect your health. • Even fireplace or solid-fuel heating lead to accumulation of PAH. • You find PAH even in smoked or grilled food.

Figure 1. Examples of colour-coded cards with description

## Results

A detailed analysis of biomarker concentration trends (Figure 2.)

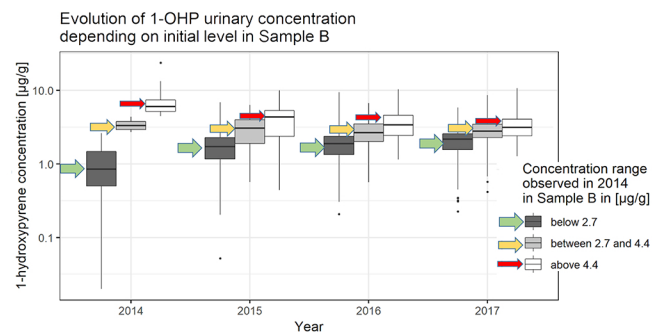


Figure 2. Examples of colour-coded cards with description

- in the group of workers that in 2014 had biomarker concentration below 2.7 µg/g (and hence received green-labelled feedback) one can generally observe an increase of biomarker levels in subsequent years, with 33% (confidence interval (CI) 29% to 38%) average increase each year
- among workers whose results in 2014 were between 2.7 and 4.4 µg/g (yellow group) a moderate decrease of analysed biomarker was observed, at rate of 8% (CI 1% to 13%) per year
- for workers with the highest results in 2014 (above 4.4 µg/g, red group) we observed higher rate of biomarker concentration decrease, namely 21% (CI 16% to 25%) per year (Table 1).

Biomarker concentration in B samples in 2014	N	Geometric mean of biomarker in 2014 [µg/g]	Concentration change multiple per year (CI)
< 2.7 µg/g	251	0.92 (0.86 – 0.98)	1.33 (1.29 – 1.38)
2.7 µg/g - 4.4 µg/g	45	3.15 (2.79 – 3.55)	0.92 (0.87 – 0.99)
> 4.4 µg/g	53	5.60 (5.01 – 6.25)	0.79 (0.75 – 0.84)

## Conclusions:

- Colour-coded information may affect on individual awareness and behavior that lead to more responsible compliance with health and safety rules, and consequently to changes in biomarker concentration in subsequent years.
- The red color was a signal to improve care for health in the workplace and significantly increased the chance of achieving a lower concentration of biomarker value in subsequent years and at the same time to minimize health effects.

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